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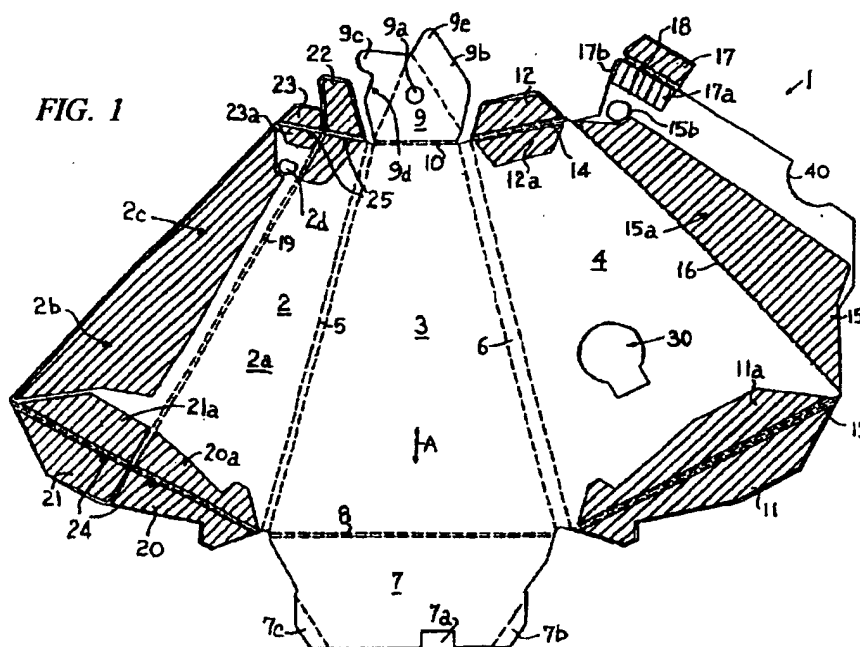
(56) Documents Cited  
GB 1582183 A WO 1997/008842 A1  
US 5732140 A US 4122911 A  
US 3942207 A

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(54) Abstract Title  
**Collapsible, foldable loudspeaker**

(57) A loudspeaker assembly comprising an enclosure made of stiff yet foldable sheet material and having at least three side walls 2-4 and at least one end wall (7,9) and a driver unit 31 mounted within the enclosure, wherein at least one of the side walls (2) has a fold line (19) extending between its ends and is foldable so that the side walls can be configured between an erected condition and a collapsed condition, and in that the or each end wall 7,9 is positionable either to retain the side walls 2-4 in the erected condition or to permit the side walls to move between the collapsed and erected conditions. The invention also relates to a blank 1 for erecting the enclosure.

The sheet material is preferably corrugated fibreboard or cardboard, but plastics are considered.  
The loudspeaker may operate on the bending wave or distributed mode principle.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG. 1

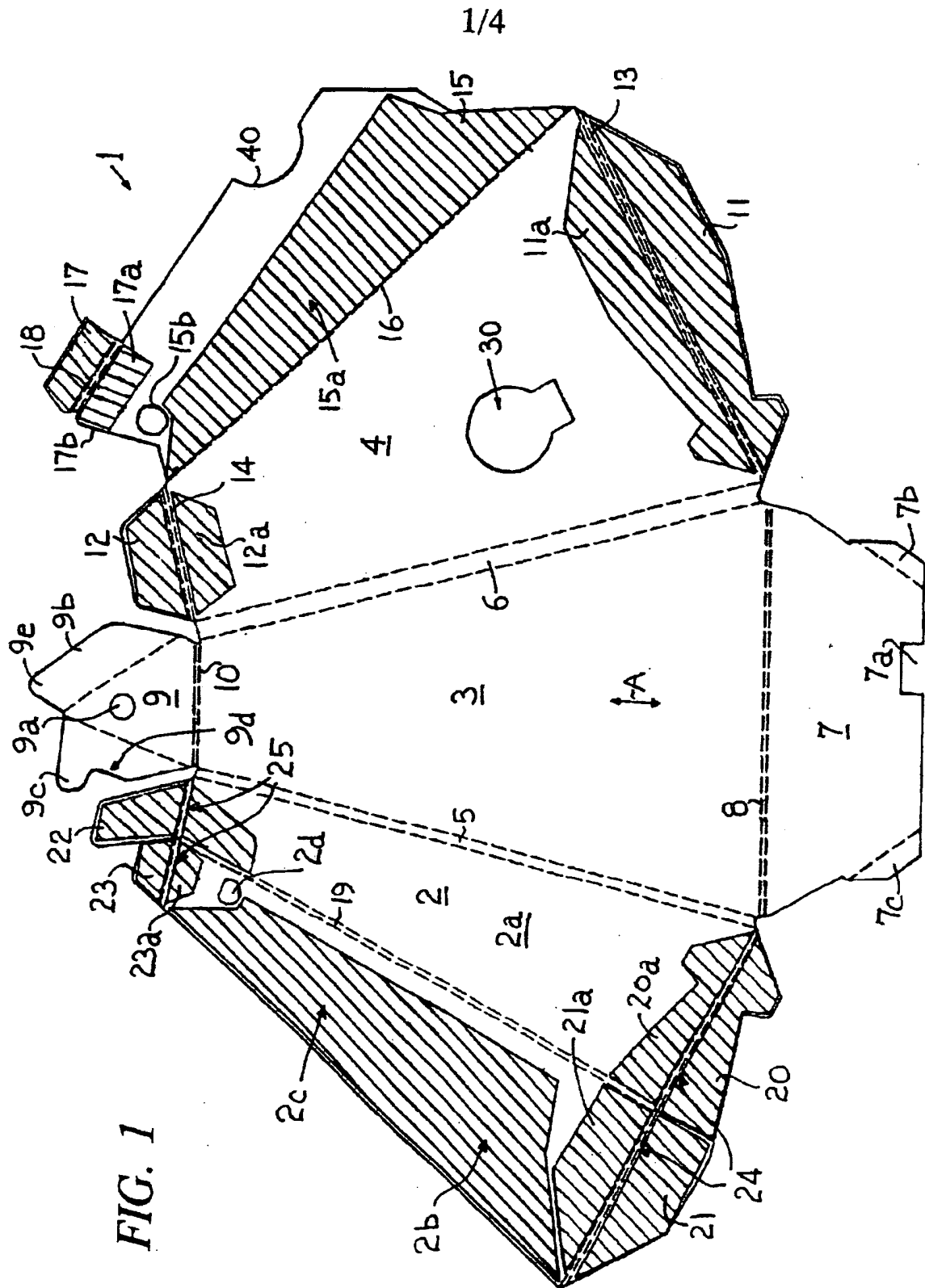


FIG. 2

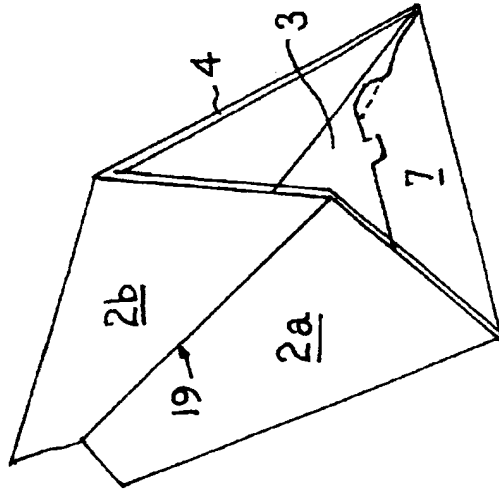


FIG. 3

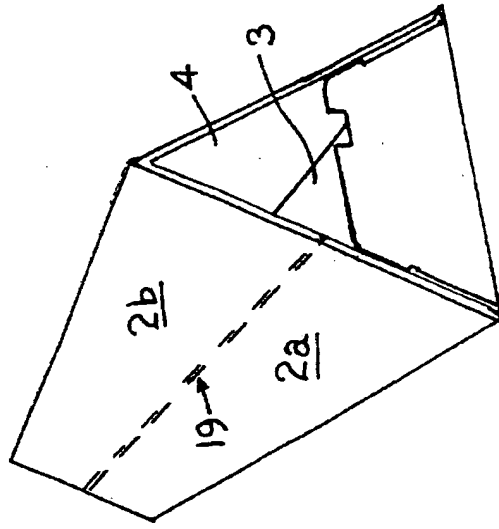


FIG. 4

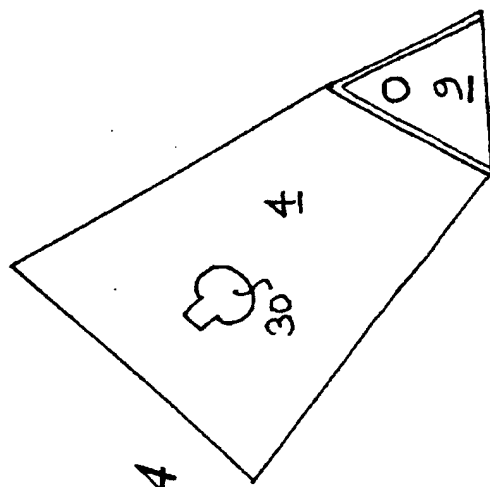


FIG. 5

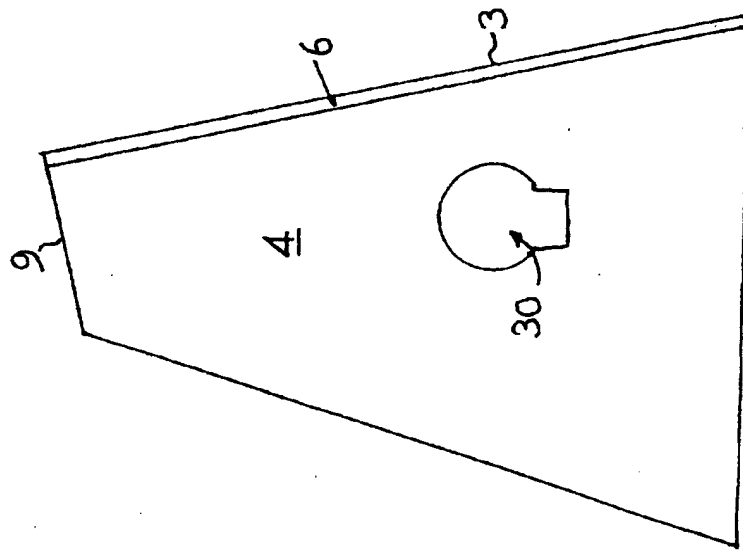
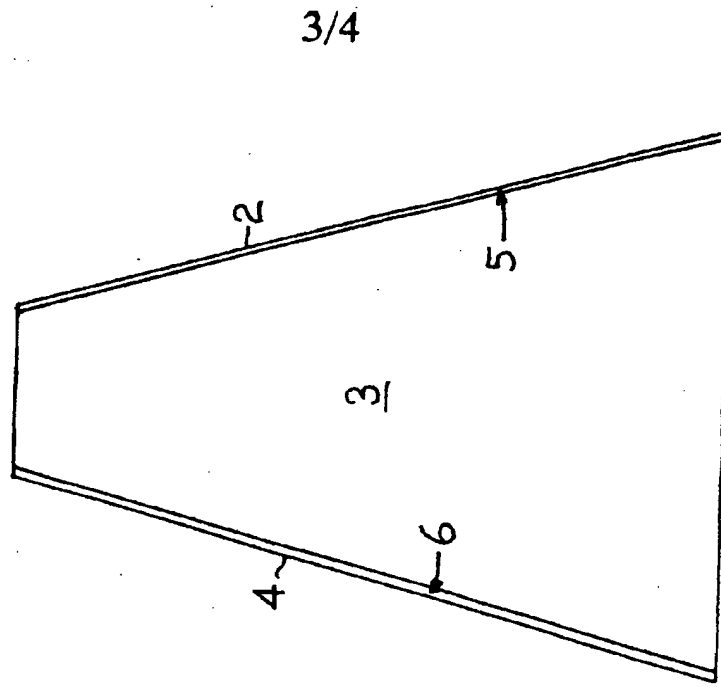
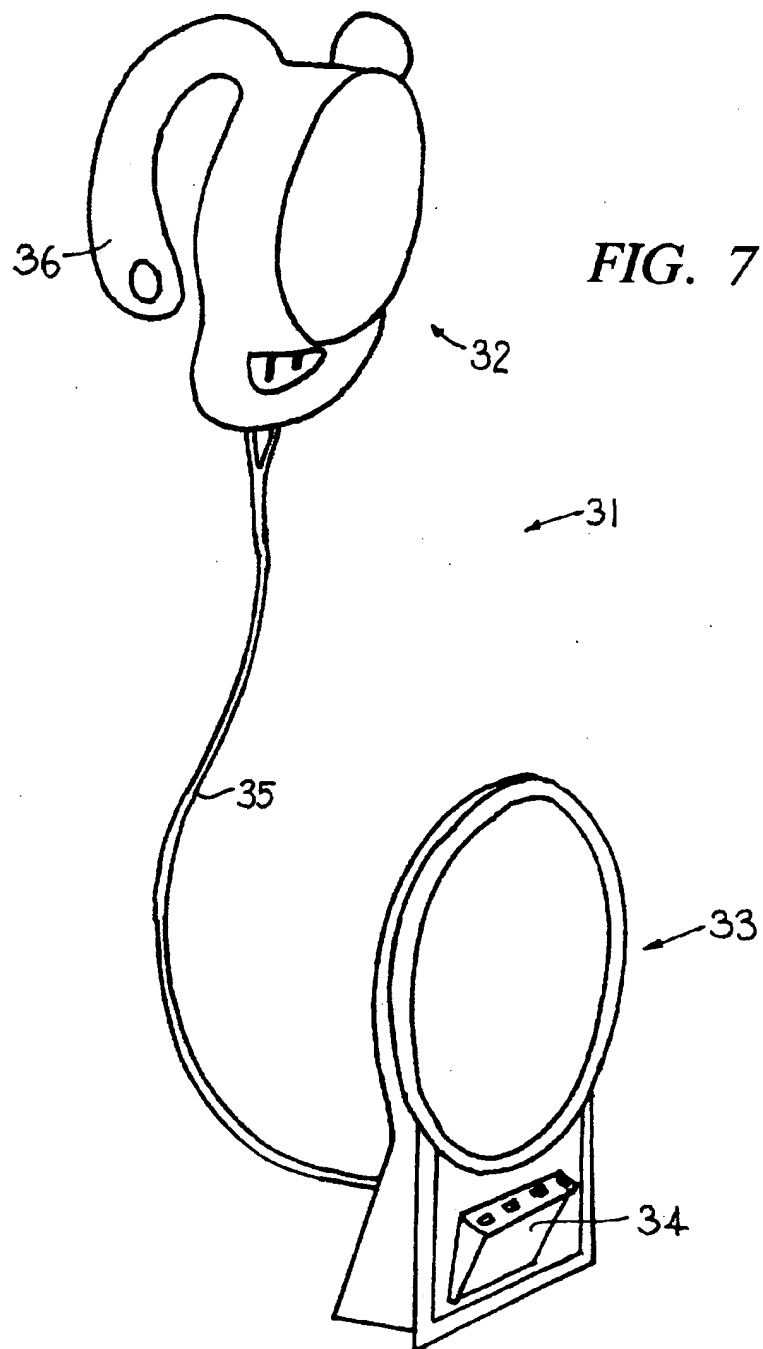


FIG. 6





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Loudspeaker

This invention relates to a loudspeaker assembly of the kind comprising an enclosure made of stiff yet foldable sheet material, e.g. corrugated material, and having at least three side walls and at least one end wall and a driver unit mounted within the enclosure. The invention also relates to a blank of stiff yet foldable sheet material, e.g. corrugated material, which is erectable into an enclosure of a loudspeaker assembly.

10 Corrugated material, such as corrugated cardboard, is well known as having good sound qualities. Examples of known loudspeaker assemblies in which corrugated material is used are WO-A-99/67,974, US-A-4,122,911, US-A-3,941,207 and EP-A-1,100,287. In each of these known loudspeaker  
15 assemblies the speaker enclosure is erected into a permanent form.

An aim of the present invention is to provide a loudspeaker assembly having an enclosure made of stiff yet foldable sheet material such as, for example, corrugated  
20 material, which can be configured between a collapsed position when the loudspeaker assembly is not in use and an erected condition when the loudspeaker assembly is in use.

According to one aspect of the present invention a loudspeaker assembly of the kind referred to is  
25 characterised in that at least one of the side walls has a fold line extending between its ends and is foldable so that the side walls can be configured between an erected condition and a collapsed condition, and in that the or each end wall is positionable either to retain the side walls in  
30 the erected condition or to permit the side walls to move between the collapsed and erected conditions.

The enclosure is designed to be collapsible and erectable many times with the end wall(s) holding or

"locking" the side walls in the erected condition. When the enclosure is collapsed, in a generally flat state, the loudspeaker assembly can easily be packed away between periods of use, e.g. at BBQs, parties and picnics. Although  
5 the enclosure is designed to be easily collapsible and portable, the loudspeaker assembly can of course be used in permanent positions in which it would remain erected.

Preferably the or each end wall is foldably connected to a respective one of said side walls. In this way the or  
10 each end wall is folded flat against the side wall to which it is foldably connected when the side walls either are in the collapsed condition or are being moved between the collapsed and erected conditions. When the side walls are in the erected condition, the or each end wall is folded up  
15 within the tubular arrangement of the side walls to hold the latter in the erected condition.

Typically the driver unit comprises a substantially flat acoustic device connected to the inside of one of the side walls. Preferably the driver unit also includes a back  
20 plate fixed to one of the other side walls and connected to the acoustic device by means of flexible lead means, the back plate including electrical connection means accessible at least when the side walls are in the erected condition to enable electrical signals to be supplied to the acoustic  
25 device. Conveniently the back plate is fixed within an aperture in one of the side walls.

Conveniently at least some of the side walls have a double thickness of sheet material at their opposite end regions.

30 Suitably the or each end wall has a main end wall panel and tab means foldably connected thereto, the tab means resiliently pressing against the side walls when the latter are in the erected condition.

Preferably the sheet material comprises corrugated material, e.g. corrugated fibreboard or cardboard.

Preferably the side walls are connected in a generally tubular configuration with an end wall at each end of the tubular configuration. Alternatively, however, the side walls, in the erected condition, could define a pyramidal structure, in which case there would only be a single end wall at the "base" of the pyramidal structure.

Conveniently the enclosure has three side walls with only one of the side walls having a fold line extending between its ends.

According to another aspect of the present invention there is provided a blank erectable into an enclosure for a loudspeaker assembly, the blank having at least three side wall panels hingedly connected together, two of the side wall panels being connectible together, and at least one of the side wall panels having a fold line extending between its ends to enable the side wall panels, in their tubular configuration, to be moved into an erected condition or a collapsed condition, and at least one end wall panel foldably connected to the end of a respective one of said side walls.

Embodiments of the invention will now be described, by way of example only, with particular reference to the accompanying drawings, in which:

Figure 1 is a plan of a blank of stiff yet foldable sheet material which can be erected to form an enclosure of a loudspeaker assembly according to the present invention;

Figures 2 to 4 are schematic views not drawn to scale showing various stages in the erection of the blank shown in Figure 1 into a loudspeaker enclosure;



Figures 5 and 6 are a side view and a front view, respectively, of the erected blank; and Figure 7 is a view of a driver unit of a loudspeaker assembly according to the present invention.

5        Figure 1 shows a blank, generally designated by the reference numeral 1, made of stiff yet foldable sheet material. A particularly preferred material having good acoustic properties is corrugated material, e.g. corrugated fibreboard or cardboard having a pair of spaced apart flat  
10 parallel outer liner sheets and one or more fluted or corrugated sheets between these outer liner sheets. If more than one, e.g. two, fluted/corrugated sheets are provided they are separate by one or more intermediate flat sheets. In Figure 1 the blank is made from corrugated fibreboard  
15 comprising spaced apart outer liner sheets sandwiching two corrugated sheets separated by a flat inner sheet, the flutes or corrugations of the corrugated sheets extending in the directions of double-headed arrow A. In the blank 1 fold lines are represented by crease lines. It will be  
20 appreciated that each fold line is formed either by a single crease line or closely spaced apart parallel crease lines represented, respectively, by a single dashed line or closely spaced apart parallel dashed lines. Shaded or cross-hatched portions of the blank represent parts of the  
25 blank which are glued together.

The blank 1 comprises trapezial side wall panels 2 - 4 (i.e. quadrilateral panels with one pair of sides parallel to each other), panels 2 and 3 being foldably joined together about a fold line 5 and panels 3 and 4 being  
30 foldably joined together about a fold line 6. A substantially trapezial bottom wall panel 7 is foldably connected to one end of the side wall panel 3 about a fold line 8 and a substantially triangular top wall panel 9 is foldably connected to the other end of the side wall panel  
35 3 about a fold line 10.

Tabs 11 and 12 are foldably connected to opposite ends of the side wall panel about fold lines 13 and 14, respectively. These tabs 11 and 12 are intended to be folded upwardly through about 180° about the fold lines 13 and 14, respectively, and adhered to correspondingly shaped shaded portions 11a and 12a, respectively, on the upper side (as viewed in Figure 1) of the side wall panel 4 to form double thickness material at opposite ends of the panel 4. A side flap 15 is foldably connected to side wall panel 4 about a fold line 16 and a tab 17 is foldably connected to the side flap 15 about a fold line 18. The tab 17 is foldable upwardly through approximately 180° about the fold line 18 for adherence to a correspondingly shaped shaded portion 17a on the upper side (as viewed in Figure 1) of the flap 11.

The side wall panel 2 has a medial fold line 19 extending from end to end of the side wall panel 2. The fold line separates the panel into two similarly shaped parts 2a and 2b with part 2b being foldable downwardly (as viewed in Figure 1) relative to part 2a about the fold line 19. Pairs of tabs 20, 21 and 22, 23 are foldably connected to opposite ends of the side wall panel 2 about fold lines 24 and 25. These tabs 20-23 are intended to be folded upwardly about the respective fold lines 24 and 25 through approximately 180° and adhered to correspondingly shaped shaded portions 20a-23a on the upper side (as viewed in Figure 1) of the panel 2 to form double thickness material at opposite ends of the panel 2.

The side wall panels 2 and 4 are folded upwardly through approximately 120° about the fold lines 5 and 6, respectively, and the shaded portion 15a on the underside (as viewed in Figure 1) of the side flap 15 is adhered to a correspondingly shaped shaded portion 2c on the upper side (as viewed in Figure 1) of the side wall panel 2 to create a partially erected tubular structure (see Figure 2). The panels 7 and 9 are folded upwardly about fold lines 8 and 10, respectively, so as to be folded substantially flat

against the side wall panel 3 inside the tubular structure. By moving the fold line 19 inwardly towards the fold line 6 the side wall panel parts 2a and 2b are folded over against each other and are sandwiched between the side wall panels 3 and 4 in a substantially flat or collapsed condition of the side wall panels. From the collapsed condition, the side wall panel parts 2a and 2b may be opened apart so as to occupy a common plane. As the parts 2a and 2b are opened the side wall panels 3 and 4 are also folded open about the fold line 6 so that the side wall panels 2-4 are configured in an erected condition (see Figures 3-6) having a substantially triangular configuration.

The side wall panels are retained in their erected condition by folding each of the bottom wall panel 7 and top wall panel 9 upwardly (see Figures 3 and 4) from a collapsed position folded flat against the panel 3 to an erected position between the side wall panels 2 and 4. Ear 9e of tab 9b prevents the panel 9 from being pulled upwardly too far from its erected position. To facilitate the manipulation of the panels 7 and 9, the top wall panel 9 is provided with a finger hole 9a and the bottom wall panel is provided with a rectangular recess 7a. In the erected position of bottom wall panel 7 folded over tabs 7b and 7c resiliently press against wall panels 2 and 3, respectively. In the erected position of top wall panel 9, folded over tabs 9b and 9c resiliently press against wall panels 2 and 3, respectively. Furthermore in the erected position of the top wall panel 9, the flat surface 9d of tab 9c is supported on the edge 17b of the folded over tab 17. To release this support prior to collapsing the side wall panels, the tab 9c is pressed inwardly by a user pressing inwardly a hinged tab 2d cut in side wall part 2b. The hinged tab 2d is pressed through a hole 15b in registry therewith formed in the side flap 15 and presses the tab 9c.

The glued and erected blank forms a loudspeaker enclosure formed of stiff yet foldable sheet material, e.g. corrugated material, which may be easily collapsed, for

storage and transport, and erected when in use. The enclosure is of frusto-pyramidal form and is intended to be used with the bottom wall panel 9 supported on the floor as shown in Figures 5 and 6. In order to save material, the bottom wall panel 7 need not (as shown) completely fill the base of the enclosure. The substantially triangular top wall panel 9 slopes from front to rear and at an angle to the base as can be clearly seen in Figure 5.

The side wall panel 4 is formed with a keyhole opening 30. This opening 30 is provided to enable a driver unit 31 (see Figure 7) to be mounted within the enclosure. The driver unit 31 consists of a substantially flat acoustic device 32, a back plate 33 having electric terminal means 34 and wires 35 connecting the terminal means 34 to the acoustic device 32. The acoustic device 32 is adhered to the inside surface of the side wall panel 3 (i.e. the upper surface of the panel 3 as viewed in Figure 1). Conveniently the acoustic device is adhered to the panel 3 when the enclosure is in its collapsed condition. When in the collapsed condition, a part circular recess 40 in the side flap 16 registers with a circular part of the keyhole opening 30. To facilitate the positioning of the acoustic device the latter may be provided with a handle 36. The back plate 33 is designed to be a push fit in the keyhole opening 30. The flexible wires 35 are able to accommodate the different spacings apart of the acoustic device 32 and the back plate 33 when the enclosure is moved between its erected and collapsed conditions. Although the back plate can be removed from its connection in the keyhole opening 30 it is designed to remain permanently fitted in use when the enclosure can be repeatedly collapsed and erected.

The acoustic device 32 may be of any suitable type known in the art. However particularly suitable transducers are described in WO 97/09859, WO 97/09861 and WO 97/09858.

The enclosure described herein is of generally frusto-pyramidal form and of generally triangular cross-

section. It is necessary for the double crease lines of the fold line 6 to be spaced apart a relatively large distance to accommodate the folded over side wall panel parts 2a and 2b between the side wall panels 3 and 4 when the enclosure is in its collapsed "flattened" condition. The double crease lines of the fold line 5 are less widely spaced apart but need to be able to accommodate the double thickness end regions of the panel 2 when in the collapsed "flattened" condition. The portions of the corrugated cardboard between the two crease lines of each of fold lines 5 and 6 could be considered to constitute side walls of the erected enclosure. However the width of these "portions" is sufficiently small for the enclosure, in its erected condition, to have an at least substantially triangular cross-section.

In other embodiments of the invention, the enclosure could have more than three side walls. For example a collapsible enclosure could be designed with four or more side walls. With a four side wall enclosure, an opposite pair of side walls could have fold lines therein to enable the enclosure to be collapsed flat. It should also be realised that the enclosure could be designed as a collapsible pyramidal structure instead of a collapsible frusto-pyramidal structure. In this latter case there would be no top wall panel. In the preferred embodiment described the bottom wall panel 7 and the top wall panel 9 are foldably connected to the side wall panel 3. Alternatively these panels 7 and 9 could be foldably connected to other ones of the side wall panels. It is even possible for the top and bottom walls to be formed of separate members, e.g. end blanks, which are push fitted into position when the enclosure is in its erected condition. Although corrugated fibreboard/cardboard is the presently preferred material for the enclosure it may be made, for example, of double skinned fluted polypropylene copolymer or of other stiff yet foldable sheet material which may or may not be corrugated or fluted and which may comprise plastics materials, e.g. EVA (ethylene vinyl acetate), EPS (polyform) or PVC.

CLAIMS

1. A loudspeaker assembly comprising an enclosure made of stiff yet foldable sheet material and having at least three side walls and at least one end wall and a driver unit mounted within the enclosure, characterised in that at least one of the side walls has a fold line extending between its ends and is foldable so that the side walls can be configured between an erected condition and a collapsed condition, and in that the or each end wall is positionable either to retain the side walls in the erected condition or to permit the side walls to move between the collapsed and erected conditions.
2. A loudspeaker assembly according to claim 1, wherein the or each end wall is foldably connected to a respective one of said side walls.
3. A loudspeaker assembly according to claim 1 or 2, wherein the driver unit comprises a substantially flat acoustic device connected to the inside of one of the side walls.
4. A loudspeaker assembly according to claim 3, wherein the driver unit also includes a back plate fixed to one of the side walls to which the acoustic device is not connected and connected to the acoustic device by means of flexible lead means, the back plate including electrical connection means accessible at least when the side walls are in the erected condition to enable electrical signals to be supplied to the acoustic device.
5. A loudspeaker assembly according to claim 4, wherein the back plate is fixed within an aperture in one of the side walls.
6. A loudspeaker assembly according to any one of the preceding claims, wherein at least some of the side

walls have a double thickness of sheet material at their opposite end regions.

7. A loudspeaker assembly according to any one of the preceding claims, wherein the or each end wall has a  
5 main end wall panel and tab means foldably connected thereto, the tab means resiliently pressing against the side walls when the latter are in the erected condition.

8. A loudspeaker assembly according to any one of the preceding claims, wherein the sheet material comprises  
10 corrugated material.

9. A loudspeaker assembly according to claim 9, wherein said corrugated material comprises a pair of spaced apart and parallel flat liner sheets with at least one sheet of corrugated material sandwiched therebetween.

10. A loudspeaker assembly according to claim 8 or 9, wherein the corrugated material comprises corrugated  
15 fibreboard or cardboard.

11. A loudspeaker assembly according to any one of the preceding claims, wherein the side walls are connected  
20 in a generally tubular configuration with an end wall at each end of the tubular configuration.

12. A loudspeaker assembly according to any one of the preceding claims, wherein the side walls, in the erected condition, define a frusto-pyramidal structure.

13. A loudspeaker assembly according to any one of claims 1 to 8, wherein the side walls, in the erected condition, define a pyramidal structure.  
25

14. A loudspeaker assembly according to any one of the preceding claims, wherein the enclosure has three side  
30 walls with only one of the side walls having a fold line extending between its ends.

15. A blank made of stiff yet foldable sheet material erectable into an enclosure for a loudspeaker assembly, the blank having at least three side wall panels hingedly connected together, two of the side wall panels being connectible together, and at least one of the side wall panels having a fold line extending between its ends to enable the side wall panels, in their tubular configuration, to be moved into an erected condition or a collapsed condition, and at least one end wall panel foldably connected to the end of a respective one of said side walls.

16. A blank according to claim 15, wherein the sheet material comprises corrugated material, e.g. corrugated fibreboard or cardboard.

17. A blank made of corrugated material erectable into a loudspeaker enclosure, the blank being constructed and arranged substantially as herein described with reference to, and as illustrated in, Figure 1 of the accompanying drawings.





Application No: GB 0127837.3  
Claims searched: 1 to 16

Examiner: Peter Easterfield  
Date of search: 2 July 2002

12

# **Patents Act 1977** **Search Report under Section 17**

## **Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK CI (Ed.T): H4J (JAB, JBA)  
Int CI (Ed.7): H04R 1/02  
Other: Online: WPI, EPODOC, JAPIO

## **Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1582183 A (WALKER)	
A	US 5732140 A (THAYER) see figs 2-5	
A	US 4122911 A (CROUP)	
A	US 3941207 A (CROUP)	
A	WO 97/09842 A1 (VERITY) see fig 54	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.